DOCUMENT RESUME

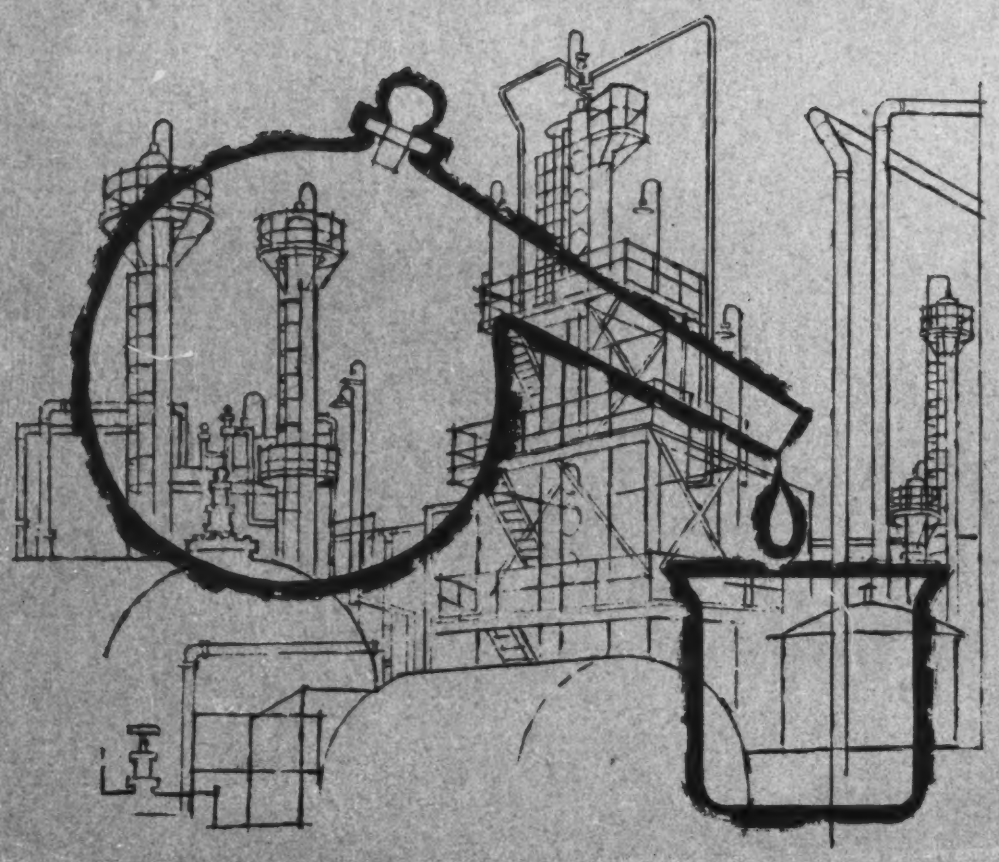
ED 040 090 SE 008 869

AUTHOR	Lee, Leroy; And Others
TITLE	Science and Society.
INSTITUTION	Madison Public Schools, Wis.
PUB DATE	69
NOTE	43p.
EDRS PRICE	EDRS Price MF-$0.25 HC-$2.25
DESCRIPTORS	*Curriculum Development, Interdisciplinary Approach, Science Education, *Scientific Enterprise, *Secondary School Science, Seminars, *Social Problems, *Teaching Guides

ABSTRACT

This is a teacher's guide to a one semester seminar course for high school students. Much of the course is based on research papers presented by students. The themes of the course are stated as: "The Role of Science in Technological Development as Related to Cultural and Social Development," and "The Role and Influence of Science in Literature, the Arts, Philosophy, and in the Governmental Process." Major areas for student topics consistent with the themes are listed and suggestions are made for course organization. Appendices include notes on writing a research paper, a brief description of what a seminar is, a selected bibliography, and a film list. (EB)

ED0 40090



SCIENCE and SOCIETY

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

Department of Curriculum Development
MADISON PUBLIC SCHOOLS
545 West Dayton Street
Madison, Wisconsin

1969

SE 008 869

ED040090

TABLE OF CONTENTS

	Page
Introduction.	1
Philosophy.	1
Course Requirements	2
Themes of the Course.	3
I. Environmental Pollution and Control	4
II. Space Exploration	4
III. Energy Sources.	4
IV. Population.	5
V. Medical Aspects	5
VI. Consumer Products	5
VII. Cities.	6
VIII. Interrelationships of the Scientific Community and The Governmental Process. .	6
IX. Conservation of Natural Resources	6
X. Cybernetics	6
XI. Science and the Arts.	7
Course Materials.	7
Suggested Course Structure.	8
The Written Paper	9
The Science Seminar	10
Bibliography for Science and Society.	10
Selected Films.	11
Library Research Project.	11
Summary	11
Appendix A The Written Research Paper	
Appendix B The Science Seminar	
Appendix C Selected Bibliography	
Appendix D Film List	
Appendix E Library Research Project	

SCIENCE AND SOCIETY

Introduction

This syllabus is designed as a teacher guide for a one semester seminar course entitled Science and Society. Portions of this syllabus would be appropriate for duplication and distribution to students; however, the syllabus is primarily intended for teachers.

Credit for the conceptual framework of this course is given to Dr. Richard A. Gorton, Professor of Education, University of Wisconsin, Milwaukee, to Mr. Marvin Meissen, Science Coordinator, Madison Public Schools, and to Mr. Bruce McN. Miller, Curriculum Associate-Science, James Madison Memorial High School.

Credit for the actual materials in this syllabus and the philosophy-design of the Science and Society course is given to Mr. Leroy Lee, Mr. Frank Zuerner and Mr. Bruce Miller all teachers at James Madison Memorial Senior High School.

Philosophy

Science and technology have aided in the solution of many problems with which society is confronted. However, in many instances science and technology have surpassed cultural and social development thus creating additional problems. This course will attempt to identify such latter problems as well as major environmental problems currently confronting mankind.

It is expected that with in-depth study of identified problems of science and society, that students can propose solutions and the merits of these solutions can be discussed in a seminar group. It is hoped that serious study of both problems and potential problem solutions will develop a student conviction that the scientific community does have a sense of responsibility and basic commitment to human problems and social needs.

The Science and Society course is not intended to emphasize the scientific method nor to extol the wonders of science. This course is not intended to formally investigate new areas of scientific discipline. Rather, it is an attempt to provide student opportunity to investigate the interrelationships between science and society. The success of this course rests heavily upon student initiative, innovativeness and research. The course requires that each student identify a specific problem(s), research this specific problem and propose alternate solutions to the selected problem. All selected research problems must be science or technology based problems of society. Formal written research papers are expected. Seminar presentation of both the research and the proposed solutions to each problem are expected.

Course Requirements

To successfully complete the Science and Society course, the student must:

1. Read and discuss selected reading materials.

2. Participate in and lead seminar discussions.

3. Select and research a major problem in science and society each nine week period. Problems selected must be in areas where science and social problems are both involved. For example, the racial problem, per se, would not be an appropriate topic for this course. However, the problem of minority group employment by the scientific community would be an appropriate problem for this course. All research topics will be discussed with and approved by the instructor before intensive research is begun by the student.

4. Propose a minimum of two alternate solutions to each selected research problem; these proposed solutions will be included as a part of the formal written paper.

5. Be prepared to debate and select one of the alternate solutions to each problem selected and presented by fellow students.

Themes of the Course

The main themes of the Science and Society course are:

I. The Role of Science in Identifying and Solving Social Problems

II. Science and Technological Development As Related To Cultural and Social Development

III. The Role and Influence of Science in Literature, The Arts, Philosophy and in the Governmental Process

The above themes are quite broad; indeed, this course could easily become so generalized that little value would be derived by the student in terms of specific topic investigation and in the identification of solutions to these problems. To avoid the foregoing, students should be required to identify specific problem topics prior to the intensive research stage of the work.

It will be useful to student guidance if the instructor spends time early in the course defining the requirements of a formal written research paper. Appendix A could be duplicated and distributed to students, for this purpose. However, the instructor should also spend class time to insure that students are well oriented to the step-by-step procedures required in a formal written paper and in the selection of a topic for research.

Major Areas of Investigation

To assist in problem identification, major areas in which research could be done are outlined below; these areas are consistent with the above themes and with the intent of this course.

Each of the major areas listed below are still much too broad for research topics. Specific topics within these major areas will need to be identified by the student, with, perhaps, instructor assistance.

To aid the instructor, each of the below listed major areas have been given possible sub-divisions. However, each of these sub-divisions would

require further specificity before a research topic could be derived. It is intended that all major areas and sub-areas shown below be flexible; additions or deletions could be made by individual teachers.

I. Environmental Pollution and Control

Includes the sub-areas of air pollution; water pollution; biological pollution; thermal pollution; nuclear pollution sources. (Specific research topics could include both the concepts of pollution and pollution control or could deal with one or the other concept individually.)

II. Space Exploration

Includes the sub-areas of spin-off benefits to society; the influence of the space programs on social structure; the technology of the space program as related to cultural and social evolution; the moral aspects of space exploration and the cost of the space program. (Again, the student must identify a specific problem within one of the sub-areas; this problem identification in the area of space exploration may be more difficult than in, for example, the pollution area.)

III. Energy Sources

Sub-areas within this category include: energy sources themselves, i.e. nuclear, solar, fossil fuel, waterpower; the distribution of energy to populations; the availability of energy sources to underdeveloped nations; the necessity of conserving certain energy sources; the potentialities of developing new energy sources to meet specific social needs. (It is suspected that specific topic identification in this area may be difficult due to the overlapping nature of the sub-areas. Resource materials may also be difficult to obtain in this general area.)

IV. Population

This area includes sub-areas of population numbers; distribution of populations; food supplies for specific human populations; basic requirements of populations; population density; birth control. (Some students may tend toward emotional involvement with this topic. It should be remembered that each student is not required to investigate every area. It should also be remembered that one of the important parameters of this course is that all topics selected for research must be scientifically based.)

V. Medical Aspects

Sub-areas in this category include: artificial body parts versus humanism; modification of personality by brain surgery; modification of personality and/or genetic codes by drugs; social relationships - consequences - implications of drug useage; abortion; pre-selection of genetic codes for human children. (Again, as in all areas, additional sub-areas may be suggested by either the instructor or the student.)

VI. Consumer Products

Sub-areas include: the automobile's role in society; the role of paper products in consumer economics; the use of plastic products to change consumer habits; quantity, production and distribution of basic consumer needs; other appropriate sub-areas. (Problem identification may be quite difficult in this area. Students may be prone toward status quo reports rather than problem identification and solution. Another difficulty in this area may be student failure to consider scientific bases for their selected topic, although this area is more technology oriented than science oriented.)

VII. Cities

Divisions of this area might be: city transportation problems; employment; waste control; basic human needs of housing, power food and clothing; recreation. (Students selecting a research topic within this area would do well to consider the question, "How Can the Scientific Community Assist in Solving the Social Problems of the City?"

VIII. Interrelationships of the Scientific Community and the Governmental Process

Problem areas which chould be investigated include: the location and use of public facilities; manipulations of world economics for national interests; conquest of raw materials sources; philosophic aspects of both science and society; the state of scientific and technological knowledge as related to governmental policies; a host of other similar topics. (Students will probably find this area one of the most fascinating for research purposes. However, again, the instructor must insist upon a scientific basis for the research.)

IX. Conservation of Natural Resources

Two important sub-areas would be: the concept of recreation versus conservation; the concept of human need today versus conservation for the future. (This area is quite broad and does overlap with some other areas listed above. Considerable student thought will be required to produce a researchable specific topic within this area.)

X. Cybernetics

Sub-areas include: computer technology; information collection; information distribution; application of computers to solve social problems. (This is a relatively new area, but a rapidly growing area of human endeavor.

Information in some sub-areas may be scarce. On the other hand, problem identification and solution should tend to be more imaginative than in some other areas.)

XI. Science and the Arts

Sub-areas include: meaningful communication of the role of science through literature, poetry and the fine arts; the use of the fine arts to express the interrelationships of science and society; the interrelationships of scientific philosophy and a particular art/literature era. (This area will be one where problem identification in the same sense as in other areas will not be possible. However, this is an areas where human endeavor in past eras was stronger than it appears today. This may also be an area where some very imaginative student ideas may emerge. It might be quite advisable for the instructor to seek an outside speaker to introduce some of the possibilities in this area to students.)

Course Materials

The following reading materials are recommended to "establish a mood and background" for the Science and Society course. Neither of these two sources provides basic research material for students. Rather, both of these recommended materials do attempt to place the evolution and role of science and technology as one complimentary to and interrelated with the society in which the scientist works:

Bronowski, J., THE IDENTITY OF MAN. Natural History Press, 1965 (Hardcover) or American Museum Science Books, 1966 (Paper.)

Harrison, J., (editor) SCIENTISTS AS WRITERS. M.I.T. Press, 1965 (Paper.)

Suggested Course Structure

To facilitate a reasonable length of time for research presentation and problem solution(s) discussion, two eighty minute seminar sessions should be scheduled each school week. The reduced class meeting time should provide for student research time. The reduced teacher time in the classroom should provide conference time to advise students in topic selection and procedural matters. It is suggested that the teacher's schedule provide for at least three hours, in addition to the 160 minutes of seminar time, for these student consultations.

Suggested Course Outline

Since it will take a few weeks before the first student is ready to present a research paper, the first few weeks of the course should provide for planned seminar group activities. These include:

1. A discussion of the philosophy, purposes and procedural operation of the course - 1 or 2 Sessions. (See Appendix B.)

2. Use of available 16mm films as background material - 2 to 4 Sessions. (See Appendix D.)

3. Discussions of the two reading materials (suggested above,) - 2 to 4 Sessions.

4. Discussions of the requirements of a formal written research paper - 1 to 2 Sessions. (See Appendix A.)

The above suggestions will require from three to six weeks, assuming two seminar sessions per week. By this time, some students ought to be ready to begin to present their research papers. It will be quite necessary for the instructor to establish a research paper presentation schedule during the first week of this course to insure that students do not procrastinate in their work to the detriment of this course. Those students who are "up to bat" first may not be able to do as extensive research as might be desired; the teacher will need to consider this problem and communicate with students concerning this time problem.

The course requirement of two research papers per semester can be achieved in terms of both the suggested course structure and course outline IF no more than 15 students are assigned to the course. If more than 15 students are assigned, modifications will be necessary such as requiring two shorter projects from some students and one longer project from others. In any event, the teacher must plan carefully the available time. Each research project presentation should be allowed one full seminar period; lesser time will not meet the needs of both in-depth presentation and in-depth seminar discussions.

5. Presentations of Research Problems and Discussions of proposed solutions - 24 to 30 Sessions. (See above discussion.)

The Written Paper

It is intended that students in the Science and Society course prepare and submit formal, written research papers. Appendix A provides detailed suggestions for the preparation of such papers. Since this Appendix may serve as a very useful guide to students, teachers will probably wish to duplicate this Appendix and distribute it to their students.

It is recognized that each student will have a varying background and ability in the preparation of written papers. The teacher must be prepared to spend some tutorial time assisting certain students in the acquisition of improved paper writing skills; cooperation with the English Department in this area might be considered. The teacher should also view each student's work in this area relative to individual student ability and improvement.

It is also recognized that the primary intent of this course is to research problems and propose solutions in the area of science and society. However, scientists increasingly are being called upon to effectively articulate their ideas and to communicate them to other members of the society. Hence, written papers should be done carefully, completely and properly.

The Science Seminar

Each teacher will view the seminar situation in terms of his own experience and attitudes. The seminar portion of this course may be handled in a variety of innovative ways. For example, students could be told that they are to play the role of a scientist presenting a report to a Congressional committee with the class playing the latter role. Another approach might be to have the student researcher playing the role of presenting a report to a group of citizens with the class playing the latter role. Each teacher will need to decide upon the structure of the small group (seminar) in terms of the particular school situation.

Appendix B is provided as a possible hand-out for students. Teachers will probably wish to duplicate Appendix B for their students or provide some alternate discussion of the nature of a seminar situation.

Bibliography for Science and Society

The bibliography presented as Appendix C is not intended to be exhaustive. Selections include representative materials for each of the major areas suggested for this course. The bibliography is intended primarily for teacher guidance. This bibliography will not be sufficient to provide in-depth study of a particular student research topic. This bibliography specifically avoids strictly factual matter in the areas of science and technology. Rather, the bibliography is intended to provide a broad range background in the problem areas germain to this course.

It is suggested that teachers do <u>not</u> reproduce this bibliography for their students. Some students will tend to use a prepared bibliography as a crutch and will thus overlook many valuable resources. Indeed, this bibliography is probably inadequate for the in-depth research of any single student research topic.

Selected Films

Many excellent films have been produced during recent years that may be used to "set the mood" for such a course as this one. In selecting the films listed in Appendix D, prime consideration was given to those films which identify problems or lead to the identification of problems related to this course. Films which presented only factual material in the areas of science, technology or social problems were eliminated from selection.

It is suggested that teachers use several of the films listed in Appendix D early in the course as stimulators for research problem identification. All films listed are available to teachers in the Madison Public Schools.

Library Research Project

Some students in the Science and Society course may have little real experience in library research techniques. In addition, since all students in this course will be using library research techniques extensively, some time early in the course should be devoted to review and practice of such skills.

It is suggested that the exercise provided in Appendix E be reproduced and used as a student exercise during the first or second week of this course.

Summary

It is hoped that the foregoing philosophy and specific suggestions for the Science and Society course will provide the basic teacher guide required for the effective implementation of this course. It is hoped that Science Departments will give serious consideration to the implementation of

this course. It is anticipated that this course will evolve into an inter-departmental, cooperative effort once the school's Science Department has piloted such a program.

This course should be modified as experience may direct. The bibliography should be periodically up-dated to insure that current social problems and scientific developments are included. Consideration should be given to ways to expand the number of students involved in this type of educational experience.

It is felt that this type of course is essential to the well rounded education of today's high school students. Indeed, the continuance of our society may well depend upon increased efforts to eliminate J. Snow's "two cultures" and substitute an effective, harmonious, cooperative, problem solving merger of these two cultures.

APPENDIX A

THE WRITTEN RESEARCH PAPER

A. Introduction

The written paper provides the opportunity to explore a subject in depth and to organize and interpret information. This process enables the researcher to become something of an authority on his topic.

B. Choosing a Topic

A good paper should begin with your interest in the subject selected for investigation. If you are interested in a topic area, but have little background in the subject, your instructor will be able to suggest one or more general articles for you to read. Then, you should use the card catalog, guides to periodical literature and available bibliographies to determine how the general area you have selected is broken down into smaller units. A broad subject such as Pollution is divided into Water Pollution, Air Pollution, Thermal Pollution and/or other units. If the unit of Water Pollution were selected, this area would be broken down into many sub-units such as Industrial Effluent Water Pollution, Farm Fertilizer Water Pollution, Water Pollution by Pesticides, Pollution of Water by Azadrin and many other sub-units.

You should now be able to select a specific unit or topic within the general topic. You must keep in mind that the topic selected must be capable of adequate research in terms of:

1. Availability of source materials. For some subjects, the available material may be too technical and complicated for you to interpret - the researcher must be able to understand his research! For example, the topic dimethyl phosphate 3-hydroxyl - a - methyl cis-crotonamide Uptake by Algal Phospholipids, would probably be a topic too technical for high school students. Other topics may have too few available resource materials for in-depth research.

2. Complexity of selected problem. The selected topic should lend itself to in-depth research in a reasonable amount of time. Generally, the student who runs into time problems has selected too broad a topic.

3. Approval of instructor. Your instructor can be quite helpful to you in determining whether or not you have selected both an appropriate topic (for the course and for your ability level) as well as whether the topic selected is too broad for adequate research.

C. Sources of Information

1. Library Card Catalog

All books available from a particular library are listed three ways in the card catalog: by author; by title; by subject. The subject card is particularly useful and can provide the following information about a book:

(a) A list of all subject headings used in the book. This data enables you to more clearly define the subject matter in the reference.

(b) How up-to-date the information is. You should always look for publication dates of references.

(c) The number of pages. This factor can be an indicator of the extensiveness of the topic treatment in the reference.

(d) The location of the book.

2. Periodical Indices

A great quantity of current information is available in periodicals. This information may range from in-depth discussions to news items. Sources may range from popular magazines to technical journals. A knowledge of how to use the periodical indices will make the task of "searching the literature" easier and will produce a more authoritative and up-to-date paper. If you are unfamiliar with these research books, you should seek assistance from the librarian. These types of research sources include:

(a) Readers' Guide to Periodical Literature. This guide indexes more than 120 periodicals of general interest. It is published monthly in paperback form.

(b) Specific discipline indices. Examples would be Biological Abstracts, Chemical Abstracts, B.A.S.I.C. and others. This type of reference will not always be found in smaller and secondary school libraries but are usually available in university and larger public libraries. They can be valuable reference sources when properly used.

(c) Discipline area indices. Examples would be Education Index, ERIC Bibliographies and others. This type of reference is not usually used by secondary school students due to the difficulty of locating materials indexed.

3. Pamphlet File

Many libraries and resource centers will file current articles and pamphlets by subject or topic area in a pamphlet file. Such files may or may not be indexed; thus, the researcher may have to pursue such files to determine their contents.

4. Encyclopedias

Encyclopedias may be both general and specific. All of these references offer a good starting point for a wide variety of topic areas. Usually, they give at least a "bird's eye view" of a topic; frequently a considerable quantity of specific information is also given.

5. Yearbooks and Annual Publications

This type of reference source provides up-to-date facts and figures relative to wide range topic areas. Examples include: The World Almanac

and Book of Facts; United Nations Yearbook; United States Census Reports; Statesman's Yearbook; Wisconsin Blue Book.

6. Bibliographies

Many selected bibliographies are available for specific topic areas; generally, such prepared bibliographies are difficult to obtain in libraries and resource centers. However, most authors presenting articles or books provide selected bibliographies. These latter bibliographies are usually located at the end of the article or book and provide valuable sources for further research.

7. Resource Personnel

Many persons with whom you will be in contact can provide ideas and specific reference sources for researching your topic area. Such persons include your instructor, the librarian, and experts in your topic field.

D. Preparation of a Working Bibliography

A working bibliography is a list on note cards of the books, magazine articles and other sources that you will use for your research. These note cards provide a record of the sources of information available on your selected topic.

Separate 3 x 5 or 4 x 6 cards are used for each entry; only one source is listed on each card enabling easy additions or subtractions to the composite list (stack of note cards). Cards are usually easier to work with than slips of paper.

Each card should also include all the facts that you will need to identify the reference and obtain it from the library or resource center. These facts include all the information required for preparation of the final bibliography which will be prepared at the end of your research paper. Necessary items include:

1. Author's name with last name first. In edited material, the editor's name appears as the author but with the notation (ed.) following the name. If the reference is unsigned, then the name of the material appears first in the bibliographic reference.

2. Title of the material. The title of a book is either underlined or capitalized; if underlining is used, each word is underlined separately. The title of an article appearing within the reference source is enclosed with quotation marks.

3. Facts of publication. This information would include for a book: publisher, city of publication, year of publication, and number of total pages. For an article within a reference source, you will need: name of periodical or reference source, volume number (if any), date of publication and pages within the reference source on which the article appears. The name of a periodical and its volume number is underlined.

4. Library call number. The inclusion of the library call number on the bibliographic note cards is valuable in locating the material. (However, this item need not be included in the research paper bibliography.)

The following are some samples of acceptable bibliographic entries for bibliography cards:

For a Book

+581.4 Bold, Harold C., Morphology of Plants. Harper and Row, New York, 1967. 452p.

For a Magazine Article

Periodical desk Phillips, Thomas Troy, "The Many Faces of Air Pollution." The American Legion Magazine, May, 1967, pp 8-13.

For an Unsigned Magazine Article

Periodical desk "Who Put Insecticides in the Milk?" The American Biology Teacher, Feb., 1969, p96.

For an Unsigned Newspaper Article

Periodical desk — "Drugs Cloak Teens' Problems." Wis. State Journal, 30 Jul., 1969, p. 10.

For an Edited Compilation of Articles

609 H87d — Hughes, Parke H. et al., The Development of Western Technology Since 1500. Mazlish, Bruce (ed.) Harper and Row, New York, 1964, 149 p.

There are other acceptable bibliographic forms than those shown above. The two important things to remember in preparing a bibliography are: (1) list all required information and (2) use a consistent form, for all entries.

E. Taking Reading Notes

Accurate and complete notes are essential for writing a good paper. You should not try to write down everything you read, but rather, skim the material first and then re-read it taking down those ideas and quotes you think you will need for your paper.

Notes should be taken on 3 x 5 or 4 x 6 cards so that the material can easily be arranged prior to the actual writing of your paper. Each card should contain:

1. The Subject Information. Such information consists of the facts and opinions required and accurately recorded. You would also include summaries, in your own words, of pertinent ideas. However, facts and quotes CANNOT be summarized in your own words.

2. Source of information and page number(s) used. This item would be similar to your bibliographic entries described above.

3. A card heading. This heading is placed at the top of the card and, in a few keywords, summarizes the contents.

Some researchers like to combine the bibliographic cards and the reading note cards using one side for each item. The disadvantages of this procedure

include lack of sufficient space for notes and the inability to separate the two types of information into two stacks. Advantages include the necessity for recording bibliographic data only once and immediate access to your notes on reading from a particular bibliographic source.

The following is an example of an acceptable note card:

Bibliographic Reference

(This may appear at the top of the card and should be placed on each note card from a particular source unless the several notecards are secured together. See preceding section for correct bibliographic entries.)

Heading		SEWERAGE DISPOSAL
Direct Quote	p 17.	"The Port of Chicago sewerage not removed by waste treatment equals the waste of a million persons."
Summarized	pp 16-24.	Primary treatment of sewerage removes 35 per cent of waste while secondary treatment removes an additional 65 per cent.
	pp 1-15.	Sewerage disposal was first open ditches - then pipelines were installed to the nearest river. Around 1900, chlorine was first added, for health reasons.

Notes which cannot be understood later or those that are incomplete or carelessly written are of little use. You can avoid re-reading and re-checking by following these simple rules:

1. Take as few direct quotations as possible selecting only key ideas for such useage. When you do copy a direct quotation, make certain there are no mistakes in the transposal to note cards. Also, include direct quotes with quotation marks or your note cards and be certain you know the author of the specific quotation. (Sometimes, authors will quote others in their work.)

2. Avoid crowding too much information on one card. Write on only one side of the card.

3. Make certain all information placed on the note card is correct the first time.

4. Write legibly.

F. Writing the Paper

A well written, significant research paper is strongly dependent upon the depth and quality of research and upon careful, thoughtful, orderly preparation of the paper. You should follow the below indicated general steps in writing your paper:

1. Review and arrange your note cards. Re-read all notes to refresh your memory and then arrange the note cards in groups based upon note card headings.

2. Prepare a preliminary outline. First, state, in one sentence the central idea of the paper. Then, make an outline showing the order of presentation of ideas. (This outline, in final form, will follow the title page of your paper and will proceed the formal portion of the paper.)

3. Write a first draft. Attempt to write this first draft at one time while the review of your notecards is fresh in your mind. If some area seems to require more data than you have, do NOT stop writing, but make a note to yourself that a section of your paper requires this additional research (and subsequent re-writing.)

4. Revise the paper.

(a) Review the contents to make certain the main points are related directly to the central theme (as stated in your preliminary outline.) Add or omit sentences, as required.

(b) Check the structure of the paper. Your introduction should lead naturally into the theme of the paper. There should be a relationship between each major idea in the paper with no abrupt shift in thought. The conclusion should be related to the introduction and should summarize the main body of the paper.

(c) Go over the paper carefully to correct all mechanical errors. Such errors are simply not allowable in a research paper!

(d) Prepare a final outline and topic sentence. This will be a revision of your preliminary outline and will provide the reader with both the theme of your paper and a table of contents.

Example of Topic Sentence and Final Outline

Note: The following is NOT an all inclusive outline of the topic selected.

Title: Pollution in Lake Mendota

Topic Sentence: Lake Mendota receives pollutants from a variety of sources.

Outline:

I. Nutrient Pollution Increases Plant Growth
   A. Run-off of agricultural and urban fertilizers.
   B. Sewerage effluent from watershed cities.

II. Excess Soil Is Washed Into The Lake
   A. Improper farming practices.
   B. Urban building practices.

III. Trash Is An Esthetic and Safety Problem
   A. Litter dropped by man into the lake.
   B. Litter washed into the lake.

IV. Chemical Upset The Lake Ecology
   A. Herbicides are added to control plant growth.
   B. Pesticides wash in from agricultural and urban areas.

Note: The left hand margin item identifiers are NOT used in your paper write-up.

(e) Include footnotes. The footnotes are essential after every direct quotation and after all important facts or opinions which are taken from resources and expressed in your own words. The footnote numbers

are sequential. You may use any footnoting form found in a variety of sources providing you are consistent in the form used. The following show one typical footnoting form which you may use:

First Time Reference Is Used	[1] Fairchild, Osborn, Our Plundered Planet. Doubleday, New York, 1948. p. 76.
If Same Reference Is Used Again	[25] Osborn, p. 125.
For a Magazine Article:	[10] Thomas Ungerleider. "Drugs and the Educational Process." The American Biology Teacher, Oct., 1968, p. 625.

You will notice the similarity of footnoting style to bibliographic style; however, specific page numbers must be stated in footnoting. It should also be noted that footnoting may be used to direct the reader's attention to certain pertinent facts or short expansions of a particular idea when including such information in the formal part of the paper would be distracting. However, do NOT use footnotes excessively - use them when required and in situations where their omission would detract from the clarity of the presentation.

(f) Prepare the bibliography. This is an alphabetical (by author) list of all resources that have been used in the footnotes and certain other resources which may be germain to your presentation. Note the change in author's name sequence shown above in the sample footnotes and the previous sample bibliographic card entries. Again, there are several acceptable bibliographic formats; you should use the same form throughout your bibliography.

G. The Completed Paper

The final draft of the paper should be typewritten, if possible, fastened into some type of folder and should have the following parts:

1. Title Page - This page contains the title centered in the upper portion of the page. It also contains your name and date of submission centered in the lower portion of the page.

2. Outline Page - This page contain the topic sentence identified as the theme near the top of the page. It also contains the final outline spaced properly and following the topic sentence.

3. Text of the Paper - The text of the paper will be consistently spaced, contain footnotes, diagrams, charts and drawings, as appropriate, in addition to the written material. The pages will also be sequentially numbered.

4. Bibliography - The bibliography is identified as such at the top center of a new page. The last page of the bibliography will also be the last page of your paper.

If the paper is typed, you should also prepare one or two carbon copies for your own retention. The original copy will be retained by your instructor.

APPENDIX B

THE SCIENCE SEMINAR

The Science Seminar is a gathering of a small group of students, under the direction of a leader, for the purpose of pursuing a specific science problem. The seminar might be under the leadership of the instructor for some purposes. It might also be under the leadership of a student; this would be particularly true when a particular student is presenting a research paper.

A seminar leader should:

1. Provide the group with general reading material prior to the actual seminar so that the group will have some subject matter background. Such material might be in the form of a short, selected bibliography and/or reproduced article(s) which will provide an overview of your topic.

2. Briefly and informally present the essential features of the researched information. The use of visual aids will increase the effectiveness of your presentation. Charts, programs and projected materials will promote interest and illustrate important points. These materials should be large enough to be easily seen by the entire seminar group, and should be sufficiently simple such that the point is rapidly illustrated. A poorly constructed or poorly used visual aid is worse than no visual aids at all.

3. Be prepared to answer questions and encourage discussion. Usually, a good discussion can be initiated by preparing a series of questions to ask which will stimulate participant thinking.

APPENDIX C - SCIENCE AND SOCIETY

SELECTED BIBLIOGRAPHY

Ardrey, R., THE TERRITORIAL IMPERATIVE. Atheneum, 1966.

Appleman, P., THE SILENT EXPLOSION. Beacon, 1965.

Agrawal, N., "The Unending Battle." New Scientist 33, 16 Feb. 1967.

Alexander, N., "Pollutants That Resist Microbes." New Scientist 35, 31 Aug. 1967.

Advisory Committee on Obstretics and Gynecology, F.D.A., REPORT ON ORAL CONTRACEPTIVES. U.S. Government Printing Office, 1966.

Advisory Committee to the Surgeon General of the Public Health Service, SMOKING AND HEALTH. U. S. Government Printing Office, 1964.

Arnold, P. and White, P., THE AUTOMATION AGE. Holiday House, 1963.

"Air Pollution - Where the Problems Are Worst." Science 157, 18 Aug. 1967.

Anderson, W. and Pizer, V., THE USEFUL ATOM. World, 1966.

American Assembly, THE POPULATION DILEMNA. Prentice-Hall, 1965.

Atomic Energy Commission, HEALTH ASPECTS OF NUCLEAR WEAPONS TESTING. U. S. Government Printing Office, 1964.

Aylesworth, T., OUR POLLUTED WORLD. American Education Publications, 1966.

AAAS Committee on Science and the Promotion of Human Welfare, "The Integrity of Science." American Scientist, June 1965.

Badgley, P., (editor,) SCIENTIFIC EXPERIMENTS FOR MANNED ORBITAL FLIGHT, Vol. 4. American Astronautical Society, 1965.

Bauer, R., (editor,) SOCIAL INDICATORS. M.I.T. Press, 1966.

Bowen, H., and Mangum, G., AUTOMATION AND ECONOMIC PROGRESS. Prentice-Hall, 1966.

Brennan, J., THE ELEGANT SOLUTION: ADVENTURE IN ENGINEERING. Van Nostrand, 1967.

Browning, T., ANIMAL POPULATIONS. Harper and Row, 1963.

Brown, R., LASERS - TOOLS OF MODERN TECHNOLOGY. Doubleday, 1968.

Bronowski, J., PICTORIAL LIBRARY OF TECHNOLOGY--MAN REMAKES HIS WORLD. Doubleday, 1963.

Bronowski, J., INSIGHT. Harper and Row, 1964.

Bronowski, J., THE IDENTITY OF MAN. American Museum Science Books, 1966.

Bernstein, J., A COMPREHENSIBLE WORLD. Random House, 1967.

Bardach, J., HARVEST OF THE SEA. Harper and Row, 1968.

Burchard, J., THE SOCIAL IMPLICATIONS OF SCIENTIFIC PROGRESS. Wiley, 1950.

Baxter, J., SCIENTISTS AGAINST TIME. Little and Brown, 1946.

Bettelheim, "Joey - A Mechanical Boy." Scientific American 210, March 1959.

Boyko, H., "Salt Water Agriculture." Scientific American 216, 3 March 1967.

Battan, L. THE UNCLEAN AIR (Science Study Series.) Doubleday, 1966.

Bragdon, C., "Noise - Syndrome of Modern Society." Scientist and Citizen 10, March 1968.

Born, J., "The Usefulness of Nicotine." New Scientist 34, 6 April 1967.

Barron, F., et al., "The Hallucionogenic Drugs." Scientific American 210, April 1964.

Berelson, B., "Beyond Family Planning." Science 163, 7 February 1969.

Blake, J., "Population Policy for Americans: Is The Government Being Misled?" Science 164, 2 May 1969.

Borgstrom, G., THE HUNGARY PLANET: THE MODERN WORLD AT THE EDGE OF FAMINE. Collier, 1966.

Bronowski, J., SCIENCE AND HUMAN VALUES. Harper, 1959.

Bronowski, J., "Science in the New Humanism." The Science Teacher, May 1968.

Berger, F., "Control of the Mind." American Journal of Pharmacy, April 1966.

Behrman, A., WATER IS EVERYBODY'S BUSINESS. Doubleday, 1968.

Bauman, R., CHEROKEE MARSH: WIN-DRAW COMPROMISE. University of Wisconsin, Extension, 1968.

Chemical and Engineering News, MAN AND HIS CITY. (Career Opportunities Issue,) C&EN News, 1968.

Chemical and Engineering News, POLLUTION - CAUSES, COSTS AND CONTROLS. (Insert) C&EN News, 9 June 1969.

Commoner, B., SCIENCE AND SURVIVAL. Viking, 1966.

Conant, J., MODERN SCIENCE AND MODERN MAN. Columbia University Press, 1965.

Caidin, M., WHAY SPACE? HOW IT SERVES YOU IN YOUR DAILY LIFE. Julian Messner, 1965.

Carson, R., THE SILENT SPRING. Houghton-Mifflin, 1962.

Cohen, I., SCIENCE - SERVANT OF MAN. Little and Brown, 1948.

Crick, F., OF MOLECULES AND MEN. University of Washington Press, 1966.

Callison, C., AMERICA'S NATURAL RESOURCES. Ronald Press, 1967.

Clepper, H., ORIGINS OF AMERICAN CONSERVATION. Ronald Press, 1969.

Christian, J., "Phenomena Associated With Population Density." Proceedings of the National Academy of Sciences 47, April 1961.

Cook, R., "How Many People Have Ever Lived on Earth?" Population Bulletin 18, February 1962.

Calder, N., "Food From Gas Oil." New Scientist 36, 23 November 1967.

Carter, L., "World Food Supply: Problems and Prospects." Science 155, 6 January 1967.

Cook, R., "U.S.A. Water Supply." Population Bulletin 17, August 1961.

Carter, L., "Technology and the Environment: A New Concept on Capitol Hill." Science 157, 18 August 1957.

Chironis, N., "Smog: The Deadly Poisons Peril Life in All City Areas." Product Engineering, 19 December 1966.

Croome, A., "Before and After Torrey Canyon." New Scientist 35, 14 September 1967.

Carter, L., "Environmental Pollution: Scientists Go To Court."

Cole, D., "Can The World Be Saved?" New York Times Magazine, 31 March 1968.

Chakerian, C., and Dupre, L., "Two Theological Views on Population Control." Population Reference Bureau Selection No. 21.

Carter, L., "Smoking and Health: FCC Demands an Antodote to Cigarette Ads." Science 157, 28 July 1968.

Cole, F., "A Witness At The Scopes Trial." Scientific American 200, January 1959.

Carson, R., THE SEA AROUND US. Oxford University Press, 1951.

Chemical and Engineering News, "Population: Technology's Desperate Race With Fertility." C&EN News, 7 October 1969.

Chemical and Engineering News, "Population: In The U. S. Amenities and Asthetics Are The Problem - Not Survival." C&EN News, 14 October 1968.

Carroll, J., "Science and the City: The Question of Authority." Science 163, 28 February 1969.

Curtis, R., "The Myth of the Peaceful Atom." Natural History, March 1969.

Clapp, L., "Science and Human Want." American Scientist, June 1958.

Conant, J., "The Impact of Science on Industry and Medicine." American Scientist, January 1951.

Clapp, L., "Can Our Conspicuous Comsumption of Natural Resources by Cyclic?" The Science Teacher, April 1969.

Chalquest, R., "Feeding the World." Biological Science, October 1966.

Carefoot, G., FAMINE ON THE WIND. Rand-McNally, 1967.

Duggan and Weatherwax, "Dietary Intake of Pesticide Chemicals." Science 157, 1 September 1967.

Dodge, B., "Fresh Water From Saline Waters." American Scientist 48, December 1960.

Du Nouy, P., HUMAN DESTINY. Longmans Green, 1947.

DeKruif, P., MEN AGAINST DEATH. Harcourt-Brace, 1952.

Davis, K., "Population Policy: Will Current Programs Succeed?" Science 158, Novemb er 1967.

Day, L., and Day, A., TOO MANY AMERICANS. Macmillan, 1964.

Dobzhansky, T., "Changing Man." Science 155, 27 January 1967.

Delyannis, A., "Water From the Sun." New Scientist 34, 18 May 1967.

Dasman, R., THE LAST HORIZON. Macmillan, 1963.

Drinkwater, F., BIRTH CONTROL AND NATURAL LAW. Helicon, 1965.

Draper, E., BIRTH CONTROL IN THE MODERN WORLD. Penquin, 1965.

DeBold, R., and Leaf, R., LSD, MAN AND SOCIETY. Wesleyan University Press, 1967.

DeCamp, L., THE GREAT MONKEY TRIAL. Doubleday, 1968.

Darnowski, V., COMPUTERS - THEORY AND USES. National Science Teachers' Association, 1964.

Dasman, R., ENVIRONMENTAL CONSERVATION. Wiley, 1959.

Dampier, W., READINGS IN THE LITERATURE OF SCIENCE. Harper and Row, 1959.

Dubos, R., PASTEUR AND MODERN SCIENCE. Doubleday, 1960.

Derry T., and Williams, T., A SHORT HISTORY OF TECHNOLOGY. Oxford University Press, 1961.

Erlich, P., "Paying The Piper." New Scientist 34, 14 December 1967.

Emery, K., and Iselin, "Human Food From Ocean and Land." Science 157, 15 September 1967.

Evans, G., and Kordesch, K., "Hydrazine Fuel-Air Cells." Science 158, 1 December 1967.

Environmental Pollution Panel, President's Advisory Committee, RESTORING THE QUALITY OF THE ENVIRONMENT., U. S. Government Printing Office, 1965.

Ebin, D., THE DRUG EXPERIENCE. Grove Press, 1961.

Elwell K., and Easlick, K., CLASSIFICATION AND APPRAISAL OF OBJECTIONS TO FLUORIDATION. University of Michigan School of Public Health, 1960.

Enke, S., "Birth Control for Economic Development." Science 164, 16 May 1969.

Etzioni, A., "Sex Control, Science and Society." Science 161, 13 September 1968.

Egler, F., "Pesticides in Our Ecosystem." American Scientist, March 1964.

Edelson, E., POISONS IN THE AIR. Pocket Books, 1966.

Ehrlich, P., "The Coming Famine." Natural History, May 1968.

Ehrlick, P., THE POPULATION BOMB. Ballentine, 1968.

Forbes, R., MAN THE MAKER: A HISTORY OF TECHNOLOGY AND ENGINEERING. Schuman, 1950.

Frank, P., PHILOSOPHY OF SCIENCE. Prentice-Hall, 1957.

Farber, S., and Wilson, R., "Air Contamination: A Respiratory Hazard." Journal of the American Medical Association 180, 5 May 1962.

Fuller, L. et al., AIR POLLUTION DATA FOR LOS ANGELES COUNTY. (From Air Pollution Control District, Los Angeles.) 1967.

Faltermayer, E., "We Can Afford Clean Air." Fortune 72, November 1965.

Frits, E., "The Redwood Parks Proposal - A Redwood Forester's View." Journal of Forestry, May 1967.

Fletcher, J., MORALS AND MEDICINE. Beacon, 1965.

Freedman, R., POPULATION: THE VITAL REVOLUTION. Doubleday, 1964.

Fortune Editors, THE EXPLODING METROPOLIS. Doubleday, 1958.

Fidell, O., (editor,) IDEAS IN SCIENCE. Washington Square, 1966.

Favar, M. (editor,) "The Unforseen International Ecologic Boomerang." Natural History, February 1969.

Glasstone, S., SOURCEBOOK ON THE SPACE SCIENCES. Van Nostrand, 1965.

Gottman, N., MEGAPOLIS. M.I.T. Press, 1962.

Gamow, G., A PLANET CALLED EARTH. Bantam, 1965.

Goldman, M., CONTROLLING POLLUTION - THE ECONOMICS OF A CLEANER AMERICA. Prentice-Hall, 1965.

Good, I., THE SCIENTIST SPECULATES. Basic Books, 1962.

Grant, M., BIOLOGY AND WORLD HEALTH. Abelard-Schuman, 1955.

Gruenberg, B., SCIENCE AND THE PUBLIC MIND. McGraw-Hill, 1965.

Guttmacher, A. (editor,) THE CASE FOR LEGALIZED ABORTION NOW. Diablo Press, 1967.

Green, L., "Energy Needs vs. Environmental Pollution: A Reconciliation?" Science 156, 16 June 1967.

Gunther, M., "The American Scientist: Man or Superman?" The Saturday Evening Post, 16 December 1967.

Giedion, S., MECHANIZATION TAKES COMMAND: A CONTRIBUTION TO ANONYMOUS HISTORY. Oxford University Press, 1948.

Gilula, M., and Daniels, D., "Violence and Man's Struggle to Adapt." Science 164, 25 April 1969.

Gardner, M., FADS AND FALLACIES IN THE NAME OF SCIENCE. Dover, 1957.

Huff, D., HOW TO LIE WITH STATISTICS. Norton, 1954.

Hall, E., THE HIDDEN DIMENSION. Doubleday, 1966.

Department of Health Education and Welfare, THE EFFECTS OF AIR POLLUTION. U. S. Government Printing Office, 1966.

Hanrahan, J., THE SEARCH FOR EXTRATERRESTIAL LIFE. American Astronautical Society, 1967.

Hasler, A., and Ingersoll, B., "Dwindling Lakes." Natural History, November 1968.

Henry, J., BIOMEDICAL ASPECTS OF SPACE FLIGHT. Holt, 1966.

Hubert, L., and Lehr, P., WEATHER SATELLITES. Blaisdell, 1967.

Hyde, J., THIS CROWDED PLANET. Whittlesey House, 1961.

Hughes, T. (editor,) THE DEVELOPMENT OF WESTERN TECHNOLOGY SINCE 1500. Macmillan, 1964.

Highsmith, R., et al., CONSERVATION IN THE UNITED STATES. Rand McNally, 1965.

Harrison, J. (editor,) SCIENTISTS AS WRITERS. M.I.T. Press, 1965.

Hogner, D., CONSERVATION IN AMERICA. Lippincott, 1958.

Halacy, D., THE WATER CRISIS. Dutton, 1966.

Halacy, D., FUEL CELLS - POWER FOR TOMORROW. World, 1966.

Hogg, G., ENGINEERING MAGIC: GIANT PROJECTS TO CHANGE THE WORLD. Criterion Books, 1966.

Halacy, D., THE COMING AGE OF SOLAR ENERGY. Harper and Row, 1963.

Helfman, E., RIVERS AND WATERSHEDS IN AMERICA'S FUTURE. McKay, 1965.

Hardin, G., POPULATION, EVOLUTION AND BIRTH CONTROL. Freeman, 1964.

Harrison, C., CONSERVATIONISTS AND WHAT THEY DO. Franklin-Watts, 1963.

Hynek, J., CHALLENGE OF THE UNIVERSE. McGraw-Hill, 1962.

Haagen-Smit, A., "The Control of Air Pollution." Scientific American 210, January, 1964.

Hanks, J., and Kube, H., "Industry Action to Combat Pollution." Harvard Business Review 44, September-October, 1966.

Hauser, P., THE POPULATION DILEMNA. Prentice-Hall, 1963.

INTERNATIONAL ENCYCLOPEDIA OF THE SOCIAL SCIENCES, 17 Volumes. Macmillan, 1968.

Jenkins, D., "Fresh Water From Salt." Scientific American 196, March 1957.

Johnson, G., and Brown, H., "Non-Military Uses of Nuclear Explosives." Scientific American 199, December, 1958.

Johnson, J., URBAN GEOGRAPHY: AN INTRODUCTORY ANALYSIS. Pergamon, 1967.

Kavaler, L., DANGEROUS AIR. Day, 1967.

Kessell, N., and Walton, H., ALCOLHISM. Penquin, 1965.

Lovell, A., THE INDIVIDUAL AND THE UNIVERSE. Harper, 1959.

Lakoff, S. (editor,) KNOWLEDGE AND POWER: EASSAYS ON SCIENCE AND GOVERNMENT. Press Press, 1966.

Low, I., "Prospects for Sea Fish Farming." New Scientist 35, 6 July 1967.

Lynch, C., "Emerging Power Sources." Science and Technology, October 1970.

Langer, E., "Chemical and Biological Warfare: The Research Program." Science 155, 13 January 1967.

Langer, E., "Chemical and Biological Warfare: The Weapons and the Politics." Science 155, 20 January 1967.

Lader, L., ABORTION. Bobbs-Merrill, 1966.

Longgood, W., THE POISONS IN YOUR FOOD. Simon & Schuster, 1960.

Lauber, P., DUST BOWL. Coward-McCann, 1958.

Ley, W., ENGINEERS' D&EAMS. Viking, 1964.

Lunetta, V., "Science and Man." Science Teacher, October 1968.

Johnson, J., URBAN GEOGRAPHY: AN INTRODUCTORY ANALYSIS. Pergamon, 1967.

Lamson, R., "The Future of Man's Environment." Science Teacher, January 1969.

Merton, R., and Nesbit, R., CONTEMPORARY SOCIAL PROBLEMS, 2nd Edition. Harcourt, 1966.

Mead, M., CULTURAL PATTERNS AND TECHNOLOGICAL CHANGE. Mentor, 1955.

MacBride, R., THE AUTOMOATED STATE. Chilton, 1967.

Miller, J., ATOMS AND EPOCHS. Twayne Publishers, 1966.

Montagu, A., CULTURE AND THE EVOLUTION OF MAN. Galaxy, 1962.

Mooney, B., THE HIDDEN ASSASSINS. Follett, 1966.

Malthus, T., ON POPULATION. Modern Library, 1960.

Marx, W., THE FRAIL DREAM. Coward-McCann, 1967.

Moroney, D., FACTS FROM FIGURES, Penquin, 1963.

Mumford, L., THE URBAN PROSPECT. Harcourt-Brace, 1968.

Malthus, T., "Mathematics of Population and Food." (J. R. Newman, editor.) THE WORLD OF MATHEMATICS. Simon & Schuster, 1956.

Mudd, S., (editor,) THE POPULATION CRISIS AND THE USE OF WORLD RESOURCES. Dr. W. Junk, The Hague, 1964.

Miller, D., "Malthus, Muddlers and Millenium." New Scientist 35, 6 July 1967.

Mattson, H., "Technology and Food." International Science and Technology 63, March 1967.

Marwick, C., "The Revival of the Steam Car?" New Scientist 38, 20 June 1968.

Morton, R., VENERAL DISEASES. Penquin, 1966.

Mausner, B., and Mausner, J., "A Study of the Anti-Scientific Attitude." Scientific American 192, February, 1955.

Milne, L., THE BALANCE OF NATURE. Knopf, 1960.

Morgenthau, H., SCIENTIFIC MAN VS POWER POLITICS. University of Chicago Press, 1946.

Moore, A., "New Challenges to Hunger." Life, 24 January 1969.

Moss, D., THE WATER CRISIS. Dutton, 1966.

McGeer, P., "Mind, Drugs and Behavior." American Scientist 50, June, 1962.

Muller, H., "Radiation Damage to Genetic Materials." American Scientist, July 1950.

MacGowen, R. et al., INTELLIGENCE IN THE UNIVERSE. Prentice-Hall, 1966.

Mair, G. (editor,) STUDIES IN POPULATION. Princeton University Press, 1949.

MCGRAW-HILL ENCYCLOPEDIA OF SCIENCE AND TECHNOLOGY, 15 Volumes. Yearbook. McGraw-Hill, 1966.

Nicholson, H., "Pesticide Pollution Control." Science 158, 17 November 1967.

Northern California Section, "The Redwood Proposals - As A Section Views Them." Journal of Forestry, May 1967.

Newman, J., SCIENCE AND SENSIBILITY, Volumes I & II. Simon and Schuster, 1961.

Nef, J., WAR AND HUMAN PROGRESS: AN ESSAY ON THE RISE OF THE INDUSTRIAL CIVILIZATION. Harvard University Press, 1950.

Oliphant, H., "The Stoned Age?" Education Age 5, January-February, 1969.

Ng, Larry and Mudel, S. (editors,) THE POPULATIONS CRISIS: IMPLICATIONS AND PLANS FOR ACTION. Indiana University Press, 1965.

Osborn, F., OUR CROWDED PLANET. Doubleday, 1962.

Oliver, J., HISTORY OF AMERICAN TECHNOLOGY. Ronald Press, 1956.

O'Donnell, J., and Ball, J., NARCOTICS ADDICTION. Harper and Row, 1966.

Osborn, F., OUR PLUNDERED PLANET. Little-Brown, 1948.

Pell, C., CHALLENGE OF THE SEVEN SEAS. Morrow, 1966.

Pirie, N., "Orthodox and Unorthodox Methods of Meeting World Food Needs." Scientific American 216, Feburary 1967.

Panel on World Food Supply, THE WORLD FOOD PROBLEM. U. S. Government Printing Office, 1967.

Popkin, R., DESALINATION: WATER FOR THE WORLD'S FUTURE. Praeger, 1968.

"Power Station Five Miles Up." New Scientist 36, 5 October 1967.

Public Health Service, THE FEDERAL AIR POLLUTION PROGRAM, U. S. Government Printing Office, 1967.

Public Health Service, THE SOURCES OF AIR POLLUTION AND THEIR CONTROL. U. S. Government Printing Office. 1966.

Potter, R. et al., "Taiwan's Family Planning Program." Science 160, 24 May 1968.

Public Health Service, THE HEALTH CONSEQUENCES OF SMOKING. U. S. Government Printing Office, 1967.

Pierce, J., "The Social Uses of Science." American Scientist, October 1954.

Prior, M., SCIENCE AND THE HUMANITIES. Northwestern University Press, 1962.

Peterson, W., THE POLITICS OF POPULATION. Anchor Books, 1966.

Revelle, R., "Fewer People? More Food?" International Science and Technology 66, June, 1967.

Rudd, R., PESTICIDES AND THE LIVING LANDSCAPE. University of Wisconsin Press, 1964.

Rapport, S., and Wright, H., SCIENCE: METHOD AND MEANING. New York University Press, 1963.

Rigenow, R., and Rigenow, L., MOMENT IN THE SUN - A REPORT ON THE DETERIORATING QUALITY OF THE AMERICAN ENVIRONMENT. Dial Press, 1967.

Street, P., VANISHING ANIMALS. Dutton, 1963.

Smith, G., CONSERVATION OF NATURAL RESOURCES. Wiley, 1965.

Sutton, M., and Sutton, A., NATURE ON THE RAMPAGE. Lippincott, 1962.

Stewart, G., NOT SO RICH AS YOU THINK. Houghton-Mifflin, 1967.

Stehling, K., LASERS AND THEIR APPLICATIONS. World, 1966.

Snow, C., THE TWO CULTURES. Mentor, 1963.

Selye, H., THE STRESS OF LIFE. McGraw-Hill, 1956.

Spilhaus, A., "The Experimental City." Science 159, 16 February 1968.

Sperry, K., "The Battle of Lake Erie: Eutrophication and Political Fragmentation." Science 158, 20 October 1967.

Swenson, H., and Baldwin, H., A PRIMER ON WATER QUALITY. U. S. Government Printing Office, 1956.

Snow, J., "Radioactive Waste From Reactors." Scientist and Citizen, May 1967.

Stone, E., "The Redwood Proposals - A Forest Scientist's Views." Journal of Forestry, May 1967.

Shapley, H., OF STARS AND MEN: THE HUMAN RESPONSE TO AN EXPANDING UNIVERSE. Beacon Press, 1958.

Sanderson, I., THE CONTINENT WE LIVE ON. Random, 1961.

Steel, E., WATER SUPPLY AND SEWERAGE. McGraw-Hill, 1960.

Shannon, J., "Science and Social Purpose." Science 163, 21 February 1969.

Smith, F., THE POLITICS OF CONSERVATION. Pantheon, 1966.

Smyth, H., "The Place of Science In a Free Society." American Scientist, July 1950.

Sears, P., "Science and Natural Resources." American Scientist, October 1956.

Singer, S., "Federal Interest in Estuarine Zones Builds." Environmental Science And Technology, February 1969.

Sears, P., "Resources Are For Using - Wisely." Science Teacher, September 1965.

"Three Hundred Billion Dollars For Clean Air and Water." U. S. News and World Report, 3 April 1967.

"The Cities." Newsweek, 17 March 1969.

Tabor, H., "Power For Remote Areas." International Science and Technology 65, May 1967.

Taylor, C., and Hall M., "Health, Population and Economic Development." Science 157, 11 August 1967.

Tyler, P., AMERICAN HIGHWAYS TODAY. Wilson, 1957.

Teller, E., and Lattner, A., OUR NUCLEAR FUTURE - FACTS, DANGERS AND OPPORTUNITIES. Criterion, 1958.

Udall, S., THE QUIET CRISIS. Holt, Rinehart & Winston, 1963.

Udall, S., "Our Perilous Population Implosion." Saturday Review, 2 September 1967.

UNESCO; CAN WE KEEP OUR PLANET HABITABLE? (Total Issue of UNESCO Courier,) January 1969.

Van Tassel, D., and Hall, M., SCIENCE AND SOCIETY IN THE UNITED STATES. Dorsey, 1966.

Walsh, J., TIME IS SHORT AND THE WATER RISES. Dutton, 1967.

Woodburn, J., CANCER: THE SEARCH FOR ITS ORIGIN. Holt, 1964.

Weinberg, A., REFLECTIONS ON BIG SCIENCE. M.I.T. Press, 1967.

Ward, B., SPACESHIP EARTH. Columbia, 1966.

Wynne-Edwards, V., "Population Control in Animals." Scientific American 211, August 1964.

Wynne-Edwards, V., "Self Regulating Systems in Populations of Animals." Science 147, 26 March 1965.

Wolman, A., "Air Pollution: Time For Appraisal." Science 159, 29 March 1968.

White, E., "Sootfall and Fallout." in Watt, W., and Bradford, R. (editors,) An E.B. White Reader. Harper and Row, 1966.

Woodwell, G., "Toxic Substances in Ecological Cycles." Scientific American 216, March 1967.

Walsh, J., "Aldabra: Biology May Lose A Unique Island Ecosystem." Science 157, 18 August 1967.

Walsh, J., "Aldabra: Reprieve For an Island." Science 158, 1 December 1967.

Woodwell, G., "Radiation and the Patterns of Nature." Science 156, 28 April 1967.

Wiener, N., THE HUMAN USE OF HUMAN BEINGS: CYBERNETICS AND SOCIETY. Houghton-Mifflin, 1954.

Wigner, E., PHYSICAL SCIENCE AND HUMAN VALUES. Princeton University Press, 1947.

Wright, J., THE WATER CRISIS. Coward-McCann, 1966.

Note: A study of this bibliography will show that certain periodicals are obviously rich sources of materials for this Science and Society course. Diligent use of the Readers' Guide To Periodical Literature will reveal a vast quantity of additional resource materials.

APPENDIX D

FILM LIST

3822 BAVI (5.00)

AUTOMATION - THE NEXT REVOLUTION. McGraw-Hill. 28 min. b/w/sd.

Assesses the potentialities and examines the dangers of rapid growth of machine labor. Explores the changes in employment patterns and transportation techniques which raise social and economic problems. Pictures the present development and relates a potential manpower shortage to a national effort in education.

7054 BAVI (11.00)

COMMUNICATIONS EXPLORATION. McGraw-Hill. 25 min. color/sd.

Surveys the latest technological developments in communications: how the computers, lasers and orbiting satellites may become departures for instant, worldwide communications at all levels. Studies the potentials of 3D-TV and how the concept of the "global village" may be realized. Observes a "talking computer" now in experimental use for banking transactions. Considers how emerging systems can actually revolutionalize man's behavior patterns.

6957 BAVI (11.00)

MAN MADE MAN (21st Century Series.) McGraw-Hill. 27 min. color/sd.

Depicts how modern technology has developed artificial materials and devices to replace damaged or diseased bones, blood vessels and heart valves. Shows the complex mechanical devices that can substitute for ailing kidneys. Interviews Dr. Wm. Koloff, inventor of the artificial kidney and Dr. Wm. Kantrowitz, transplant specialist. Shows the medical researcher in his search for new devices such as artificial hearts and electrified artificial limbs.

M1600X Public Health Service (Free)

DAY AT THE DUMP. PHS. 18 min. color/sd.

The story of Kenilworth Dump, Washington, D. C. Compares the population increase to per capita trash increase and available disposal techniques. Sets statistical stage for solid waste disposal per capita needs. Illustrates how dump areas may be converted into useful, sanitary recreational areas.

F 3119 Madison Public Schools

NUCLEAR POWER IN WORLD POLITICS. WBCTV, 1967. 20 min. b/w/sd.

Study of nuclear proloferation providing global view of one of the great problems today . . . survival in the atomic age. Interviews with world leaders. Includes sequences of atomic tests, delivery mechanisms and nuclear establishments of the leading powers.

F 327 Madison Public Schools

POPULATION ECOLOGY. MGHT, 1961. 19 min. b/w/sd.

Analyzes the biological principles of environment as they relate to surplus or decline of births over deaths. Man, with his ability to change environment, has created a problem of birth surplus over number of deaths giving rise to a biological and sociological phenomenom which we call the population explosion.

F 3096 Madison Public Schools

OUR VANISHING LAND. MGHT, 1967. 24 min. color/sd.

Designed to create a better understanding of the problems of conservation now confronting this nation. Instances are cited of some of the things that have already happened or likely to happen as the price of progress.

F 3097 Madison Public Schools

PEOPLE BY THE BILLIONS. MGHT, 1961. 28 min. b/w/sd.

Migration to another planet? A fanciful nation today, but one which may hold the only hope for elbow room 500 years from now. This film examines the implications of the population explosion already underway.

M1418X Public Health Service (Free)

POISONED AIR (CBS Series by Daniel Schorr.) PHS, 1967. 50 min. color/sd.

Depicts St. Louis and Pittsburgh air pollution both before and after clean-up of the atmosphere of those cities. Animation combined with actual scenes as well as laboratory shots lend the films versitility of approach. Both the industrial and public health aspects are examined. Interviews with executives of the automobile industry, Mayor Lindsay and Norman Cousins are conducted. Problem solutions such as precipitrons, waste condensation, atomic power sources and battery operated vehicles are examined.

F 3298 Madison Public Schools

THE CITY AND THE FUTURE (Part 6) Sterling, 1964. 28 min. b/w/sd.

In more and more regions of the world the inevitable and urgent choice must be made - low grade urban sprawl or a new kind of regional city. This last film of the series examines prospects for the city and ways to restore its role as the focus of man's highest achievement.

F 3295 Madison Public Schools

THE CITY - CARS OR PEOPLE? Sterling, 1964. 28 min. b/w/sd.

A study of an old but dangerously growing problem - how to make the city accessible for meeting and mixing without allowing transportation to make it conjested and uninhabitable, as the private motor car now threatens to do.

F 3099 Madison Public Schools

TO EACH HIS RIGHTFUL SHARE. MGHT, 1960. 28 min. b/w/sd.

This film presents a broad canvas, encompassing the world, against which it studies the great stirring of humanity in search of a better means of life.

APPENDIX E

LIBRARY RESEARCH PROJECT

1. Select and List a Topic Area: _____

   State the Relationship of the topic area to the course: _____

   _____

2. Write a topic sentence: _____

   _____

   _____

   Instructor Approval: _____

3. Summarize the information found on the topic in an encyclopedia. (Use Reverse of this page.)

   Name of Encyclopedia: _____

   Publication Date: _____

4. Using the Readers' Guide To Periodical Literature, list three recent references pertinent to your topic:

   (a) _____

   (b) _____

   (c) _____

5. Magazine Subject Index

   (a) Scientific American (Find the most recent article related to your topic.)

   _____

   (b) Choose any other science journal (e.g., Science, Nature,) and find the most recent article related to your topic.

   _____

   (Use full bibliographic reference form, above.)

6. Select one of the references listed in (4) or (5), above, and obtain the references cited in the article. Select and list two of these references (from the end of the article) that relate to your topic. Use bibliographic form below:

   (a) _____

   (b) _____

7. Locate one of the references listed in (6), above, and from this article (or book) list one additional reference related to your topic; use bibliographic form below:

_____

8. From a yearbook, or similar publication, obtain one statistical fact related to your topic.

Publication _____ Year _____ Page ____

State Statistic: _____

9. Look up three words closely related to your topic in an unabridged dictionary. Record their derivation and meaning:

(a) _____

(b) _____

(c) _____

10. From a library card catalog, list three references in which information on your topic can be found. Include all publication data:

(a) _____

_____

(b) _____

_____

(c) _____

_____